US Wind Turbine Database Summary

Version: USWTDB V3.2
Release Date: October 14, 2020

I. ACRONYMS:

AWEA	American Wind Energy Association
DOF	Digital Obstacle File
FAA	Federal Aviation Administration
LBNL	Lawrence Berkeley National Laboratory
OE/AAA	Obstruction Evaluation / Airport Airspace Analysis
USGS	United States Geological Survey
EIA	Energy Information Administration
USWTDB	United States Wind Turbine Database

II. ABOUT THE DATABASE:

In 2016, USGS, LBNL, and AWEA began collaborating on development of the USWTDB. Their goal was to create a joint product that would be more comprehensive and accurate than their individual wind turbine data sets. Federal agencies began using these combined data in March 2017, and in April 2018 the data were released to the public. The database is maintained and updated quarterly to reflect new turbine additions, removals, and changes to the data.

These data are used by government agencies, scientists, private companies, and citizens for a variety of analyses. Examples include operational impact assessments of turbines on air defense radar, weather and general aviation, analyses related to the role of wind energy in the U.S. electric grid, interactions between wind energy facilities and wildlife, and investments in wind energy infrastructure.

The data were created by combining publicly-available data sets from the Federal Aviation Administration (FAA), USGS data from a prior effort, online sources, and data privately held by AWEA and LBNL. The locations of all turbines are visually verified to within plus or minus 10 meters using high-resolution imagery. Technical specifications data of the turbines are collected from wind energy developers, equipment manufacturers, and from online sources.

III. DATA SOURCES:

Data were added, compiled, and updated in this edition of the USWTDB using the following sources:

- USGS Onshore Industrial Wind Turbine Locations for the United States — Release Date: March, 2014
- LBNL Wind Turbine Database — Release Date: March, 2017
- FAA Digital Obstacle File (DOF) — Release Date: August 11, 2020
- FAA Obstruction Evaluation (OE/AAA) — Release Date: July 31, 2020
- AWEA Q3 2019 Wind Turbine Dataset — Release Date: July 31, 2020

- EIA Form 860 ER – Schedule 3 – Wind Data Release Date: June 2, 2020
- USGS Visual Verification (satellite imagery) Date: September, 2020

IV. VARIABLE CHANGES OR ADDITIONS:

No variables changes or additions this quarter.

V. VARIABLE NAMES AND DEFINITIONS:

Variable list and definitions can be found in the codebook that accompanies this release.

VI. SUMMARY OF DATASET AND CHANGES THIS QUARTER:

This edition of the USWTDB contains **65,548** turbines distributed across 43 U.S. States, Guam, and PR. Changes and updates to the database this quarter include the following:

- Addition of 3,661 turbine records. Additions include:
  - 1,849 new turbines.
  - 1,812 existing turbines issued new case_id. Replaces old records.
- Removed 2,666 turbine records. Removals include:
  - 787 decommissioned turbines.
  - 1,812 turbines issued new case_id. Replaced by new records.
  - 38 reclassified as "not a turbine"
  - 28 duplicate turbines removed.
  - 1 residential scale turbine (<= 50 kW) identified and removed.
- A total of 14,709 attribute changes were made. These include:
  - 584 "faa_asn" updates.
  - 1,170 "p_name" updates.
  - 250 "p_year" updates.
  - 3,248 "p_tnum" updates.
  - 1,993 "p_cap" updates.
  - 474 "t_manu" updates.
  - 809 "t_model" updates.
  - 202 "t_cap" updates
  - 12 "t_hh" updates
  - 40 "t_rd" updates
  - 40 "t_rsa" updates
  - 901 "t_ttlh" updates.
  - 1,618 "t_conf_atr" updates.
  - 1,401 "t_conf_loc" updates.
  - 1,840 "t_img_date" updates.
  - 32 "t_img_srce" updates.
  - 44 "xlong" updates.
  - 51 "ylat" updates.

NUMBER OF WIND TURBINES BY STATE:

The USWTDB currently includes wind turbines from 44 U.S. states, plus Guam and Puerto Rico. Table 2 reports the number of turbines in each of these states and territories for the current release (Q3-2020) as well as the previous quarterly release (Q2-2020) for comparison. The changes by state reported in Table 2 may be due to turbines added to the dataset (via FAA and AWEA data) and/or duplicate and decommissioned turbines removed from the dataset.

Table 2: Summary of Turbines by State

State	Q2-2020	Q3-20202	Change
AK	142	**142**	0
AR	1	**1**	0
AZ	144	**146**	2
CA	7,455	**6,833**	-622
CO	2,689	**2,741**	52
CT	3	**3**	0
DE	1	**1**	0
FL	1	**2**	1
GU	1	**1**	0
HI	132	**132**	0
IA	5,627	**5,723**	96
ID	541	**541**	0
IL	3,105	**3,141**	36
IN	1,265	**1,371**	106
KS	3,472	**3,507**	35
MA	92	**92**	0
MD	80	**80**	0
ME	386	**392**	6
MI	1,254	**1,337**	83
MN	2,699	**2,698**	-1
MO	792	**886**	94
MT	556	**556**	0
NC	105	**105**	0

State	Q2-2020	Q3-2020	Change
ND	2,121	**2,121**	0
NE	1,317	**1,385**	68
NH	84	**84**	0
NJ	6	**6**	0
NM	1,174	**1,259**	85
NV	68	**68**	0
NY	1,142	**1,142**	0
OH	503	**503**	0
OK	4,107	**4,397**	290
OR	1,937	**2,064**	127
PA	751	**751**	0
PR	63	**63**	0
RI	32	**32**	0
SD	1,005	**1,060**	55
TN	18	**18**	0
TX	15,706	**15,895**	189
UT	208	**208**	0
VA	0	**2**	2
VT	73	**73**	0
WA	1,770	**1,772**	2
WI	452	**452**	0
WV	396	**396**	0
WY	1,077	**1,366**	289
TOTAL	64,553	**65,548**	995

VII. CONFIDENCE IN TURBINE LOCATIONS:

The level of confidence[1] in turbine latitude/longitude coordinates remains very high, thanks to the visual verification efforts from USGS. Currently, 61,156 (93.3%) turbine points have high location confidence, and only 6.2% of turbines have low location confidence. 100% of the turbine locations in this dataset have been visually examined using satellite imagery. Location confidence of points is summarized in Table 3.

Table 3: Level of confidence in turbine locations

Location Confidence	Q2-2020		**Q3-2020**	
	Freq.	Percent	Freq.	Percent
(3) High	60,223	93.3%	**61,156**	**93.3%**
(2) Partial	249	0.4%	**344**	**0.5%**
(1) Low/none	4,081	6.3%	**4,048**	**6.2%**
(0) Not checked	0	0.0%	**0**	**0.0%**

We are aware of the existence of turbines in the dataset that have a *high* location confidence but have been dismantled. These would be turbines that were previously verified but have since been decommissioned. If users are aware of any turbines that have been dismantled but remain in the dataset please send an email to uswtdb@lbl.gov with details about them, or use the "submit a suggested correction" button via the USWTDB online viewer. Note that the *case_id* for the turbine being corrected will automatically be included if you use the button via the viewer. If you submit a correction via email, please include *case_id.*

[1] **Location confidence** (conf_loc) is rated on a 0-3 scale:
0—Not visually verified (these points are in the queue for verification in the next quarter)
1—No turbine shown in image; image has clouds; imagery older than turbine built date
2—Partial confidence: image shows a developed pad with concrete base and/or turbine parts on the ground
3—Full confidence: image shows an installed turbine or a tower being constructed; at least partially installed

VIII. CONFIDENCE IN TURBINE ATTRIBUTES:

The level of confidence[2] in the attributes (such as total height, hub height, and rotor diameter) of each wind turbine remains high. We have high confidence in attributes for 83.7% of the turbines, partial confidence in 6.9% of turbines, and low or no confidence in 9.4%. Turbine points are categorized as "partial" confidence if the AWEA attribute data conflicts substantially[3] with existing records. Attribute confidence is summarized in Table 4.

Table 4: Level of confidence in turbine attributes

Attribute Confidence	Q2-2020		**Q3-2020**	
	Freq.	Percent	Freq.	Percent
(3) High	53,291	82.6%	**54,839**	**83.7%**
(2) Partial	5,114	7.9%	**4,532**	**6.9%**
(1) Low/none	6,148	9.5%	**6,177**	**9.4%**
(0) Not checked	0	0.0%	**0**	**0.0%**

The seven attributes that are collected are well populated across the dataset. Each attribute is populated in at least 89% of turbines, and over 89% of turbines in the USWTDB have data populated in *all seven* turbine attributes. Attribute data are summarized in Table 5.

Table 5: Number of turbines with data populated and summary statistics for seven turbine attributes

Turbine Attribute	**# of Turbines**	**% of Turbines**	**Minimum**	**Median**	**Maximum**
Project year	64,055	97.72%	1981	2011	2020
Total height (m)	58,629	89.44%	30.4	125.6	199.6
Hub height (m)	58,629	89.44%	19	80	131
Rotor diameter (m)	58,911	89.87%	11	90	154
Capacity (kW)	59,571	90.88%	50	1800	6000
Turbine Manufacturer	59,569	90.88%	*n/a*	*n/a*	*n/a*
Turbine Model	59,245	90.38%	*n/a*	*n/a*	*n/a*
All Seven Attributes	*58,479*	89.22%	*n/a*	*n/a*	*n/a*

[2] **Attribute confidence** (conf_attr) is rated on a 1-3 scale:

1—No confidence: no facility data, no name, nothing in publications
2—Partial confidence: incomplete information or substantial conflict between data sources
3—Full confidence: consistent information across multiple data sources

[3] A "substantial" conflict was defined as any of the following differences (+/-): p_year 4 years; t_hh 10 meters; t_rd 10 meters; t_ttlh 50 feet; t_cap 250 kW. These tolerances will also be examined in the coming quarters and are expected to tighten over time.